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Commentary

Individuals versus aggregates: The pros and cons of each perspective in examining offender choices

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In this article, Professor Johnson raises a very interesting, important, and timely set of questions. Chief amongst these is, as Johnson writes, 'whether there exist (spatial) patterns in sequential choices' of offenders. This issue has, of course, been touched upon from a certain perspective previously; any method for generating prospective hotspot maps from historical and recent criminal activity is in some sense attempting to answer this question, by predicting future crime locations (both spatial and temporal) using the locations of previous crimes (Bowers, Johnson, & Pease, 2004; Mohler, Short, Brantingham, Schoenberg, & Tita, 2011). However, there is a somewhat subtle difference between the goals of prospective hotspot mapping and what Johnson is referring to here.

Prospective hotspot mapping techniques typically place no emphasis on exactly who is committing the predicted crimes, whereas Johnson is really asking how individual offenders make their decisions. Of course, if a 'good' model of how individuals choose their targets can be made, such a model can then be used to create prospective hotspot maps; the inverse is not necessarily true, however. That is, suppose that a good model for individual offender choices exists, and it depends on various parameters belonging to each criminal – his home location, his routine activity anchor points and paths between them, his predilection for committing crimes in general, his desires to cluster or spread his crimes, etc. – then, if one also possesses (or can estimate) the probability distributions for these parameters over the entire criminal population, a prospective hotspot map can be made by averaging the hotspot maps of each of the many individual offender types (parameter combinations), weighted by the probability that such a criminal exists and has committed some portion of the recorded prior crimes. On the other hand, for a 'good' method of creating a prospective hotspot map, this averaging has in a sense already been done, and it is quite difficult, if not impossible, to invert this and discover all the various criminal types that contribute to this average.

As a simplification, one could assume that all criminals are in fact of the same type, so that the average accurately represents the way any given individual will behave. However, this is most likely not true, and this assumption is therefore a perfect example of the ecological fallacy. Unfortunately, most studies of distance-to-crime data, and the inter-event-distance analysis performed in this article,

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succumb to this alluring simplification. Specifically, Johnson here has taken the inter-event distances for all his datasets, lumped them together, and plotted (Figure 3), and from these plots attempted to ascertain whether certain models of criminal foraging – Brownian motion and Levy flights – are consistent with the data. They may well be, but if we allow for varying parameters/preferences between individuals, there are many other possible models that will also be consistent with the aggregate data, any of which may not individually reproduce the aggregate trends at all. Hence, the aggregate data may in fact tell us very little (or nothing) about what the individuals are actually doing, from a mechanistic point of view.

The alternative, of course, is to analyse each individual separately, to see where he falls in parameter space given the assumed model. I myself, along with my colleague George Mohler, have performed this very analysis in an attempt to develop a new solution – also based on ideas from animal foraging – to the geographic profiling problem (Mohler & Short, 2012). However, there are several issues that arise. First, most of the offenders within our dataset, as in Johnson's, have only a small number of crimes associated with them, making any parameter estimates subject to large margins of error. Second, in the face of these small number statistics, it becomes quite difficult to ascertain the 'goodness' of the model. One can of course compare amongst and between several competing models to determine the best of the bunch for a given metric (the choice of which is itself subject to debate), but this is not as satisfying as a more individual goodness measure, such as an R^2 value.

The biggest issue, however, is actually the question raised by Johnson in this work, which I quoted before: 'whether there exist (spatial) patterns in *sequential* choices'. That is, are the choices made by offenders somehow conditioned on the choices they have made previously, and if so, how? I believe that it is reasonably well settled that offenders certainly do condition their choices on prior acts to at least some extent, which has led to certain methods of crime prediction and prospective hotspot mapping. However, when it comes to analysing the crimes of individuals in an attempt to ascertain exactly how that offender conditions his crimes on the past, the fact that most offenders in the dataset committed very few crimes makes this nearly impossible to do with any level of certainty. That being said, given a sufficiently reasonable model for offender choice, justified through means other than this difficult data analysis, this uncertainty in exact parameter values may not necessarily cause large problems in the usage of the model and best-fit parameters to perform a practical task such as geographic profiling or crime linkage analysis. I think this is an area of research that presents a lot of opportunities and challenges for the future, and this article has provided a very fine jumping off point.

Finally, I would like to mention that, although determining from data exactly how individual offenders condition their crimes on their history may be quite difficult, further inquiry into how the aggregate crime data are conditioned on historical and recent activity may be quite fruitful in the domain of prospective hotspot mapping. Here, I am imagining conditioning that takes on a more complex structure than the simple linear approximations typically made, and in which the predictions made are more dependent on the ordered history of the process, rather than simply on the aggregate history.

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